RESEARCH REPORT

Intervention Procedures for the Development of Educational Materials In Elementary Mathematics with a Focus on Primary Geometric Concepts

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To remediate cognitive deficits associated with mathematics curricula taught to visually handicapped children, a program of materials development in primary mathematics is being undertaken at the American Printing House for the Blind (APH). The objective underlying the development of mathematics materials is to produce instructional aids which illustrate concepts used in a variety of teacher prescribed activities and which reinforce the teaching dynamic encountered between pupil and instructor.

Special educators have consistently recognized the cognitive deficits visually handicapped children display in relation to adequately demonstrating successful understanding of mathematical concepts. The frequent retardation of about 20% found among the blind in achievement in mathematics verifies these observations (Hayes, 1941; Nolan and Ashcroft, 1950).

Educational aids and devices developed by teachers of the visually handicapped have not consistently maintained high standards of quality, have not generally relied upon existing relevent research, have not had written explanations identifying their purposes and instructional uses, and consequently have been inappropriate for APH production (Franks, 1971). Systematic appraisal of curricular perplexities in mathematics undertaken by trained diagnosticians for purposes of developing educational materials is a recent innovation. The outgrowth of these investigations has been a more calculated endeavor to observe and analyze

instructional procedures, learning deficits, and curricular concepts to produce prescriptive materials that meet the needs of a population of visually handicapped children experiencing cognitive deprivation with the prevailing mathematics curricula.

The emphasis on the mathematics curricula made available within the past ten years has shifted from rote memory work, repetitive exercises, and unrelated clusters of mathematical facts to one of a conceptual understanding of mathematics as a system of related ideas based on logical descriptive and visual processes. As this is the approach for developing modern mathematics programs it becomes the task of the educational researcher to identify the conceptual deficits a particular population of exceptional children are experiencing and to plan a systematic approach to materials development which will supplement remediation techniques employed in the classroom.

An analysis (Chart 1 appended) of the following primary level mathematics series has been conducted which identifies the range and sequence of topics, associated vocabulary, and suggested instructional aids in the geometry concept area (Foster, 1971).

1. Addison Wesley Series, Elementary School Mathematics Books 1 through 3.
2. Science Research Associates Series, Greater Cleveland Mathematics, Books 1 through 3.
3. Silver Burdett Series, Modern Mathematics Through Discovery Books 1 through 3.
4. Laidlaw Series, Mathematics, Sets, Numbers, Numerals, Books 1 through 3.
5. Houghton Mifflin Series, Modern School Mathematics Structure and Use, Books 1 through 3.

The instructional objectives of each text series are defined in relation to the importance placed on understanding geometric concepts at the primary level. The strategies which facilitate the learning proces-

in each text series are described best in the Greater Cleveland Mathematics Program (1968):

1. Questions are emphasized more than answers.
2. Reasoning and understanding are stressed rather than memorizing rules.
3. Every effort is made to develop an idea prior to the use of words that name the idea. Language is useless without ideas; the language of math is learned as the pupil participates in the developmental activities.
4. Many of the activities require the child to manipulate objects and make generalizations.
5. Basic facts are learned by referring to a model or picture.
6. Models or pictures are used to develop the concepts associated with the operation.
7. Visual models are used extensively in deepening perception of number structure.
8. Models or pictures are presented as theoretical or real life examples.

These guidelines provide the foundation for the presentation of geometric concepts found in the curricula. It is apparent that the method of presentation for the sighted child is quite visual and intuitive encouraging the child consumer to make logical inductive decisions about the learning tasks.

All of the mathematical concepts involve undefined abstractions characteristic of intuitive i.e. (to look at) geometry. Child consumers visualize and describe mathematical operations, rather than assigning precise definitions to the operations (Duncan, 1970). Inductive decisions imply formal conclusions by reasoning from the particular to the general. Duncan and his associates identified this process when they stated that the principal aim of their work is to develop

an intuitive understanding of the concepts which will help students to interpret the physical world they see around them. They further acknowledge that ...

> Children learn more effectively by working with physical objects than by being "told" or shown a relationship demonstrated. Discovery activities in which the students work with objects are therefore an important part of our program. For many children the work in this series will merely involve learning vocabulary to describe what they already know. On the other hand, one must be careful that the work involves real experiences and does not deteriorate into mere verbalism (Duncan, 1970).

An in-depth Geometric Concept Analysis at the primary level (Chart II appended) of Modern School Mathematics, Structure and Use, Houghton Mifflin, newly adopted by AMI for large print and braille transcription, indicated that this series presents advanced geometric concepts at earlier grade levels than any other series outlined in Chart I. The analysis was undertaken to identify the learning objectives outlined for the child consumers, remediation relations the text author employed in presenting concepts, visual processes occurring on the printed page which facilitate learning, and the interplay of "real life" and abstract examples which illustrate mathematical functions. It is of prime importance to record this methodology as a functional basis for relevant materials development.

In Chart II the geometric figures of circle, square, and triangle are presented at grade levels, I, II, III and related geometric concepts are introduced using these figures for illustration. It is appropriate to develop materials to illustrate these concepts, providing raised line drawings for Level I, raised line drawings in conjunction with tangible plane figures for Level II, and a combination of raised line drawings, tangible plane figures, and three dimensional figures for Level III. An alternate approach to the development of

the materials would involve reversing the sequence of presentation in Levels I and II by providing tangible plane figures at Level I, and raised line drawings in conjunction with tangible plane figures at Level II. The order in which tangible plane figures, raised line drawings and three dimensional figures are presented at Level III may not have any significant effect on how the student learns. This approach is partially adapted from mathematics teaching strategies which specify that primary aged children are presented new topics in a sequential order beginning with the social experience which presents a situation within the experiential background of the child; then the concrete manipulation step utilizing tangible apparatus; then the visualization step which illustrates concepts with pictures, drawings, diagrams, and charts; and finally the abstract step which presents conconpts with symbols alone (Dutton, 1961). Consequently, the adapted method used with visually handicapped students would provide for tangible plane figures to be presented prior to raised line drawings. The difference in sequence of presentation points up a problem current educational research using blind Ss has not answered: Is it more educationally appropriate to present tangible plane figures prior to the introduction of raised line drawings or after the introduction of raised line drawings when illustrating concepts associated with specific subject matter?

A perusal of all the mathematics series listed previously indicates no agreed preference among texts regarding methods of illustrating geometric figures for sighted students at the first grade level e.g. Houghton Mifflin uses outline figures; SRA uses outline figures; Addison Wesley uses a combination of outline figures and outline figures with regions colored; Silver Burdett uses dashed outline figures and

colored figures of real life examples; Laidlaw uses outline figures, outline figures with regions colored, and colored figures of real life examples. Since there is no agreement on the method of illustration at the first grade level, the order of sequencing of methods cannot be determined either. If there were some agreement among text authors regarding method and sequence of illustrating geometric figures, adapted materials for visually handicapped child consumers could follow similiar strategies. General teaching practices usually provide raised line drawings as counterparts for print outline drawings and tangible plane figures as counterparts for print outline drawings with colored regions. There is no empirical evidence which specifies the order of sequence when presenting raised line drawings and tangible plane figures to visually handicapped child consumers. Since this inconsistency is evident it should be a concern in the design of the geometric forms study.

Each level of the Materials Development Prospectus at the primary level (Chart III appended) is a summation of the concept analysis which outlines the instructional objectives and terminal behaviors visually handicapped child consumers should master to understand the scope of concepts related to the geometric figures of circle, square, and triangle presented in the primary grades. Level I of the prospectus introduces the concepts of curve, inside and outside, circle, square, triangle, and regions of the three geometric shapes. Level II of the prospectus introduces the concepts of line, line segment, point, congruence, sides, and corners while reviewing the concepts presented in Level I. Level III of the prospectus introduces the concepts of angle, right angle, plane, parallel lines, sphere, cube, and an in

depth investigation of the properties of a circle. Each level is concerned with the application of concepts to the geometric figures of circle, square, and triangle. All objectives are sequentially developed in a logical presentation based on the Geometric Concept Analysis.

An analysis at the intermediate level (Chart IV, V appended) was conducted employing identical objectives as those specified for the primary level. The first phase of the intermediate analysis (Chart IV) identified those concepts which can be illustrated using raised line drawings, plane figures, and three dimensional figures without additional tangible apparatus needed to perform the indicated operations. The nature of this information was similiar to that found in the analysis at the primary level. The first phase of the analysis at the intermediate level included only grade levels IV and V.

The second phase of the analysis at the intermediate level (Chart V) included grade levels IV and V and all of level VI and identified performance operations which deal with measurement and construction of geometric figures. Concepts in geometry at the intermediate level are performance oriented and require students to manipulate apparatus in order to draw conclusions about the materials being studied. A performance operation requires the student to manipulate a ruler, compass, or protractor to construct and/or measure a figure for purposes of understanding the concept involved. As an example, at the fourth grade level, the student will draw and measure line segments using a ruler, construct three dimensional figures such as a pyramid, cube, and cone, and draw rectangles of specified measures and compute their area. At the fifth grade level, the student will use a ruler to measure line segments and perimeters of different figures,

use a protractor to draw and measure angles, draw circles without using a compass, and draw graphs. At the sixth grade level, the student will draw and measure line segments, use a protractor to measure angles, use a compass to draw circles, and measure the volume of specified figures.

At the primary level students use a ruler to draw and measure line segments and to measure the sides of geometric shapes. The attention given to understanding the geometric concepts associated with measurement is secondary to the emphasis placed solely on measurement. However, at the intermediate level devices such as a ruler, compass, and protractor are important in facilitating the understanding of geometric concepts. Many of the concepts presented at the intermediate level have been introduced at the primary level, but the methods in which students deal with the concepts change. The methods of understanding geometric concepts involve operational procedures in which the student manipulates devices, draws figures, measures line segments and angles and computes volume. The analysis at the primary level indicated that students identify the characteristics of different geometric figures while at the intermediate level, students must use measurement devices and construct figures to obtain answers to questions dealing with geometry. Since the concepts at the intermediate level involve performance operations which complicate teaching methods, it is recommended that an additional project be undertaken to determine ways in which the ruler, compass, and protractor should be used to supplement the presentation of geometry materials to be developed at the intermediate level.

The author is currently formulating a project to design and develop prototypes of primary geometric materials illustrating concepts found in the Geometric Concept Analysis. Prototypes will be developed to specifically illustrate the Materials Development Prospectus which is adapted for visually handicapped child consumers. Close attention will be given to refining the prospectus to present instructional objectives and terminal behaviors which most adequately facilitate concept attainment related to the geometric figures of circle, square, and triangle. In formulating a design to assess the effectiveness of the geometry prototypes consideration will be given to setting up comparison groups and varying the sequence of the presentation of the three classes ~~of figures~~ i.e. (raised line, tangible plane, and 3 dimensional) for purposes of verfying the appropriate sequencing method of presenting geometry materials to visually handicapped children. When the instructional programs and prototypes have been designed, pilot testing will ensue to assess the effectiveness of the materials developed.

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CHART I

PRIMARY TEXTBOOK ANALYSIS
RANGE AND SEQUENCE OF TOPICS, ASSOCIATED VOCABULARY, SUGGESTED INSTRUCTIONAL AIDS

Concept Area: Geometry

Addison Wesley Series, Elementary School Mathematics
Books 1 through 3.
Science Research Associates Series, Greater Cleveland Mathematics
Books 1 through 3.
Silver Burdett Series, Modern Mathematics through Discovery
Books 1 through 3.
Laidlaw Series, Mathematics, Sets, Numbers, Numerals
Books 1 through 3.
Houghton Mifflin Series, Modern School Mathematics Structure and Use
Books 1 through 3.

Range and Sequence of Topics	Associated Vocabulary	Suggested Instructional Aids
Grade I		
1. Identification of circles, squares, triangles, & rectangles 2. Comparison of different sized circles, squares, triangles, rectangles 3. Ideas of points & line segments (3) 4. Closed curve (1) 5. "The shortest distance between 2 points is a straight line" (1)	above after angle area before below between center center point chord circle closed compass congruent	ruler number line toys of different sizes plane models in wire and/or plastic in various sizes (Judy Property Blocks & Stick-O-Mats, square with a 10" diagonal, square corner, etc.)
Grade II	cube cylinder diagonal diameter end point graph inside larger last left line line segment next opposite outside parallel parallelogram path plane	flannel or magnetic board and geometric shapes solid models (cube, etc.) compass & desk protector tracing paper simple street map squared paper book with squared corners volleyball, basketball, baseball classroom globe magazine pictures of geometric shapes 1/4" wide strips thumbtacks
1. Ideas of inside, outside, on, region (1) 2. Drawing & using points & line segments including diagonals (2) 3. Center, radius, & diameter of a circle 4. Square corners 5. Symmetry (2) 6. Congruence (1) 7. Simple closed curves including circles, squares, triangles & rectangles (1) 8. "Only 1 line can be drawn through 2 points, but many lines can be drawn through 1 point." (1)		

GRADE III

1. Regions of a plane (inside & outside) & properties of plane figures
2. Drawing circles with a compass (1)
3. Parallelogram & parallel lines (2)
4. Angle, exterior & interior angles (1)
5. Constructing right angles
6. Quadrilaterals
7. Cube & its properties (1)
8. Sphere (1)
9. Cylinder (1)
10. Constructing rectangles & squares by folding paper (1)
11. Families of lines through a point (1)
12. Family of circles through 2 given points (1)
13. Three points not on 1 line determine exactly 1 circle (1)

point
quadrilateral
radius
rectangle
region
right
right angle
roundness
shape
shortest
sides
simple
smaller
space
sphere
square
square corner
symmetric
triangle
volume

heavy string
crayons
paste
scissors

CHART II

Geometric Concept Analysis - Primary Level

CONCEPT AREA: Geometry

GRADE LEVEL: I

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
1. Identify curves which are closed and not closed.	a. The term "closed curve" is used to identify closed shapes. b. Pictures of objects illustrate "closedness".	1) Child identifies closed curves using objects or experiences from real life situations. 2) Pictures are of activities and objects that child may perform or recognize from personal experience.
2. Identify closed curves	a. Closed curves have no openings.	1) Child is to identify which figures are closed curves. 2) Abstract representation of previous lesson. Child has to work with geometric figures rather than "real life" situations. 3) Square and triangle are presented as possible examples of closed curves in exercise.
3. Identify points inside and outside of closed curves.	a. Points within the figures are inside. b. Points external to the figures are outside.	1) Letters are identified which are inside and outisde closed curves. 2) Point is introduced visually, by placing a dot next to each letter. 3) Place holder square is used for recording answers.
4. Construct closed curves around specified letters presented on the page.	a. Closed curves can be drawn. b. Closed curves have random shape. c. Different points are inside and outside curves. d. Points have names.	1) Child constructs a closed figure. 2) Points are referred to for the first time; called points A, B, C, etc.

CURRICULUM AREA: Mathematics

CONCEPT AREA: Geometry

GRADE LEVEL: I

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS
5. Identify points inside, outside, and on closed curves.	a. Points appear randomly inside, outside and on closed curves.	1) Child distinguishes between the 3 different concepts in recording answers. 2) Point is introduced visually on the line of a closed curve.
6. Draw a closed curve around specified letters on page.	a. A random number of points may be identified as inside, outside, and on a closed curve.	1) From 2 to 4 points are used in drawing the curves. 2) In one construction 3 points are presented - could form triangle if straight lines were connected at the points.
7. Recognition of triangle and rectangle.	a. The association of a name identifying a specific shape is developed.	1) Identify triangles using right triangle as examples; right and equilateral are possible choices. 2) Identify rectangle with different shaped rectangles as examples. Circle is used as a possible choice.
8. Recognition of square and circle.	a. The association of a name identifying a specific shape is developed.	1) Child identifies circles and squares from examples provided. 2) An equilateral triangle and rectangles appear in the examples. 3) Two circles presented; one same size as examples, one larger than example.

CONCEPT AREA: Geometry

GRADE LEVEL: I

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS
9. Recognition of triangle, square, circle, rectangle as examples of special closed curves.	a. Geometric shapes may appear in real life examples.	1) Matching task - abstract figure to same shape displayed in real life objects. 2) Reverse process in presenting abstract and real life examples. 3) In discussing closed curves real life situations were presented before abstract examples were given. With geometric figures just the reverse occurred, abstract figure presented before real life examples were given.
10. Recognition of circle, triangle, square and rectangle.	a. Associate name with geometric shape.	1) Geometric figures of random size and color are presented. Child selects the appropriate figures from each example.
11. Identify the "regions" of circle, square, triangle, and rectangle.	a. The region of the geometric shape is the entire area inside the shape.	1) Color the regions of the 4 figures - (color coding incidental process).
12. Identify the regions of different geometric shapes, ie. circle, square, triangle, rectangle, on a picture of a "stick figure" man.	a. The region of each shape is defined as the colored area of the shape.	1) An example of each shape is color coded. Children must color geometric areas on stick figure according to color coded examples.

CONCEPT AREA: Geometry

GRADE LEVEL: II

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
1. Introduction to points and lines - property of a line	a. Points are on a line b. Lines do not stop c. Lines meet at a point	1) Points are illustrated on a line set up to resemble a number line. Child records answers via observation.
2. To learn the difference between line and line segment.	a. Lines do not stop b. Lines can be given names c. Line segments have end points d. Line segments can be given names e. Points on line and line segment are assigned letters which are used to name them.	1) The difference between a line and line segment is illustrated; points are shown on lines. 2) Names are assigned to line segments. 3) Child counts line segments found in real life situations.
3. Points and line segments are identified.	a. Line segments have names b. Line segments have end points which are labeled with letters to name them. c. Line segments can be used to construct objects.	1) Children name line segments 2) Children name line segments making up a construction 3) Children are incidently reinforced that points appear on line segment. 4) Constructions are identified which are made up of line segments.
4. Line segments of equal length can make up a number line.	(Relative to Geometry) a. Equal line segments separate points on a number line. b. Line segments can be joined to make a larger line or line segment. c. Concept of length is introduced in relation to line segment.	1) Child identifies number of points between specified intervals on number line.

GRADE LEVEL: II

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
5. To demonstrate congruence by matching identical curves.	a. Recognition of congruent curves b. Curves given names, using letters c. Distinguish between curve and other figures	1) Matching curves
6. To identify closed curves and "not closed curves" using real life examples.	a. Recognition of a closed curve	
7. To identify simple curves	a. Difference between simple curve and one that is not.	1) Child identifies simple curves from illustrations using an example as a reference.
8. To identify simple and closed curves.	a. Difference between simple and closed curves. b. Examples of figures which are not simple or closed curves.	1) Recognition; no examples given
9. To recognize geometric shapes of circle, rectangle, square, triangle.	a. Match shapes through recognition.	1) Examples are given of each shape, child identifies each shape. 2) Word recognition of shapes introduced.
10. Name geometric shapes from example provided.	a. Associate a label with a geometric shape b. Varying sizes of same figure have same properties of geometric shape	1) Child names shapes using memory recall. 2) No examples are labeled.

CONCEPT AREA: Geometry

GRADE LEVEL: II

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
11. To identify the number of sides and corners of triangle, rectangle, square	a. Triangle, rectangle, and square are simple closed curves. b. Each figure has a certain number of sides and corners. c. Sides with equal measures are identified in triangle and square and rectangle	1) Child names objects 2) Counts sides 3) Counts corners 4) Identifies congruent sides within one figure
12. To identify squares, rectangles, and triangles within complex figures.	a. Simple figures can be combined to make complex figures b. Simple figures within complex figures still maintain their properties. c. Two figures may have a common side d. Congruence is incidently dealt with.	1) Visual recognition Child is required to answer questions by visually recognizing and discriminating shapes.
13. To identify interiors of curves; circle, square, rectangle, triangle	a. Inside is identified using color coding in an example. b. Inside is identified in relation to circle, square, rectangle, triangle. c. Point is associated with a letter inside the figure.	1) Visual recognition Child is required to answer questions by visually recognizing and discriminating regions.
14. To identify inside and outside of figures presented; circle, triangle, and square.	a. A point or points are shown inside and outside the figures. b. Figures are superimposed demonstrating inside and outside.	1) Visual recognition Child is required to answer questions by visually recognizing and discriminating inside from outside.

CONCEPT AREA: Geometry

GRADE LEVEL: II

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
15. To identify inside and outside of each curve presented.	a. Two or more points can be inside or outside a curve. b. The term "curve" is used to refer to figures used in previous lessons. c. Points are associated with letters inside and outside figures. d. Points on an unrelated line are shown to be inside and outside a figure drawn through it. e. Points may be inside two different figures at the same time.	1) Visual recognition Child is required to answer questions by visually recognizing and discriminating inside from outside.
16. To identify the regions within circles, rectangles and triangles.	a. The area inside a closed curve is a region. b. Each shape has a region. c. Regions are color coded in examples but are not in exercise.	1) Visual recognition Child is required to answer questions by visually recognizing and discriminating regions of specified shapes.

GRADE LEVEL: III

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
1. To recognize curves, lines, line segments . Given an example of each.	a. Some curves go on and on. b. A line is straight and goes on and on. c. A line segment is found in part of a line and has two end points.	1) Visual recognition; identify curve, line, and line segment from real life examples.
2. To name line segments and distinguish points on lines.	a. Two points are needed to name a line or line segment. b. Names vary according to how letters are read on a line c. Notation for writing names of lines is presented.	1) Child identifies line names and points from examples.
3. To identify curves, line segments, and rays using end points to distinguish the properties of one from another.	a. Lines have no end points. b. Line segments have two end points. c. Rays have one end point. d. Lines and rays are theoretically pictured with arrows at each end of the line.	1) Identify curves, line segments, and rays 2) Write names.
4. Draw lines, line segments, and rays using a specified numbers of points.	a. Lines, segments, rays are drawn through points. b. Letters are assigned to points to name lines, segments, and rays. c. Varying numbers of lines may be drawn from one or more points.	1) Constructions as outlined in exercises.

GRADE LEVEL: III

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
5. To identify a plane surface, given an example of a plane. Exercises.	a. Plane surfaces are flat. b. Any line segment connected by two points which lies entirely in the surface is a plane.	1) Intuitive reasoning; using an example to choose correct answers. 2) Real life examples given. Identify planes.
6. To identify the properties of curves. Exercises.	a. There are three types of curves 1) curves 2) closed curves 3) simple closed curves b. Curves need not be closed c. Closed curves may have lines crossing one another. d. Simple closed curves do not have lines crossing one another.	1) Visual recognition using examples; identify 3 types of curves 2) Drawing curves.
7. To identify the properties of angles. Exercises.	a. Angles are made up of two rays. b. Angles have a common end point called the corner point. c. One angle can have at least two different names. d. The symbol $\angle$ stands for angle.	1) Intuitive reasoning; given examples, identify rays, angles, and end points.
8. To recognize a right angle. Exercises.	a. Right angles are special types of angles. b. Examples of right angles can be found in the classroom. c. Paper can be folded to construct right angles.	1) Visual recognition through examples 2) Paper folding

CONCEPT AREA: Geometry

GRADE LEVEL: III

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
9. To identify the properties of parallel lines.	a. Parallel lines do not meet. b. Parallel lines may have line segments in them. c. Line segments in parallel lines are also parallel. d. Examples of parallel lines exist in real life. e. Two sets of parallel lines crossing each other form angles.	1) Visual recognition using an example. 2) Name lines parallel to one another. 3) Name angles constructed by parallel lines crossing each other. 4) Real life examples are given: identify parallel lines.
10. Exercises	a. line b. line segment c. right angle d. parallel lines e. curve f. ray g. end points	1) Identify each, given examples.
11. Exercises - joining line segments using triangle and quadrilateral	a. A triangle has three line segments called sides. b. A quadrilateral has four line segments called sides c. The end points of the sides are called corner points.	1) Questions asked about sides, angles, corner points. 2) Cut paper and cardboard to make constructions. 3) Triangle, square; flexible corners to change shape of figure.
12. Exercises - rectangles and squares	a. A rectangle is a special quadrilateral. b. A square is a special rectangle. c. The sides of a square are of equal length.	1) Questions asked about angles and parallel sides.

GRADE LEVEL: III

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
13. Exercises - diagonal lines	a. A diagonal line divides a rectangle into two triangles.	1) Questions asked about diagonal. 2) Questions asked about square and rectangles.
14. Properties of the circle	a. The circle is perfectly round b. Every point on the circle is the same distance from the center point. c. A circle is similar to a wheel.	1) Real life examples are given 2) Construction
15. Exercises involving the diameter and radius of a circle.	a. A circle with a diameter the same size as the side of a square will fit inside the square. b. A diameter is the measure of the distance across the circle through the center. c. A line segment making up half the diameter is called a radius.	1) Constructions
16. Exercises - inside and outside.	a. Statement identifying inside, outside, and on a curve with accompanying picture. Understand position of each.	1) Identify points which are inside, outside, and on closed curves.
17. Exercises - regions	a. The area outlined by a simple closed curve is called a region.	1) Geometric forms are colored coded to indicate the regions inside the closed curve. (circle, triangle, rectangle, square) Name shapes of regions. 2) Name points on geometric shape and within its region. (rectangle, triangle)

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
18. To identify the properties of circles.	a. A circle is a closed curve. b. More than one circle can have the same center. c. Circles have a radius and diameter d. A diameter divides a circle in half; a diagonal divides a square in half. e. Radiuses of the same circle are of equal length. f. Two radiuses form an angle within a circle.	1) Visual recognition using an example; answer questions regarding the properties of a circle.
19. Circles - Continued	a. Circles may have different size radiuses b. End points of a radius (line segment) may serve as either the center of a circle or a point on the circle.	1) Constructions.
20. Matching sides	a. The diameter divides a circle in half. b. The diagonal divides a square in half. c. Shapes whose parts match are called symmetrical.	1) Constructions 2) Name symmetrical objects
21. Symmetry - Exercises	a. A line which separates a shape into two matching halves defines the halves as symmetrical.	1) Question asked: "Do you think symmetrical objects look better than objects which are not symmetrical?"
22. Angles - Exercises	a. Angles can be symmetrical b. The angle between the corner of a building and level ground is a right angle.	1) Observation - compare shapes of angles.

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TAUGHT:	TEACHING PROCESS:
23. Right angles - Exercises	a. Paper may be folded to outline four right angles. b. Right angles are the same size. c. Rectangle and squares has right angles. d. Triangles may have one right angle and may be symmetrical. e. Two right triangles the same size fitted together fonma square or rectangle.	1) Observation- name right angles. 2) Discover congruence between two right angle triangles.
24. Parallel Lines - Exercises	a. If two lines in the same plane do not meet, they do not form an angle. Two lines of tnis kind are parallel. b. An object with a square corner is placed on parallel lines;pupil may draw a right angle, or two more parallel lines.	1) Examples of parallel lines including street intersection are given; constructions and identifications of parallelograms are made.
25. Exercises - parallelograms	a. Example of parallelogram is given. b. Surface area is measured. c. Example is given (square) and student determines if it is a parallelogram.	1) Given example, answer questions.
26. Spheres and cylinders - Exercises	a. A name for a hollow ball is sphere. b. A name for a hollow can is cylinder.	1) Characteristics of both are compared.
27. Exercises - shperes and cubes	a. Visual example of cube and sphere are presented. b. Without going through the surface of a cube or sphere you can not get inside the object.	1) Real life examples given of sphere and cube. Questions asked regarding properties of both.

CHART III

MATERIALS DEVELOPMENT PROSPECTUS

PRIMARY LEVEL

MATERIALS DEVELOPMENT PROSPECTUS

CONCEPT AREA: Geometry

GRADE LEVEL: I - Raised Line Drawings

INSTRUCTIONAL OBJECTIVES	TERMINAL BEHAVIORS
1. Identify closed curves	a. Understand definition of closed curve b. Identify examples of closed curves 1) circle 2) square 3) triangle
2. Identify inside and outside	a. Examples of closed curves are presented and letters are identified inside and outside geometric figures b. Concept of point is introduced and understood by placing a dot next to each letter. c. Inside and outside are located without reference points. d. Letters are defined as point a, b,c, etc.
3. Identify circle, square, and triangle	a. Name figures b. Name figures of varying shapes and sizes
4. Identify regions of circle, square and triangle	a. Locate surface area of three figures and identify as regions 1) texture surface 2) color coding b. Understand outline of figure defines region.

MATERIALS DEVELOPMENT PROSPECTUS

CONCEPT AREA: Geometry

GRADE LEVEL: IT - Plane Figures

INSTRUCTIONAL OBJECTIVES	TERMINAL BEHAVIORS
1. Identify line, line segment and point. (Consideration should be given to using raised line drawings to accomplish this objective.)	a. Understand definition of line and line segment. 1) A line has no end points. 2) A line segment has end points. 3) A line segment may be part of a line. b. Understand line segments and points are labeled with letters to name them. c. Understand points may appear on a line. d. Locate and name points and line segments on a line. e. Name line segments outlining specified curves. 1) square 2) triangle
2. Recognize congruence of identical curves.	a. Match curves of identical shape. 1) circle 2) square 3) triangle
3. Icentify circle, square, triangle.	a. Correctly identify examples. 1) vary sizes 2) identify letter names which label figures.
4. Identify number of sides and corners of square and triangle.	a. Count sides b. Count corners c. Identify congruent sides within one figure.

MATERIALS DEVELOPMENT PROSPECTUS

CONCEPT AREA: Geometry

GRADE LEVEL: II - Plane Figures

INSTRUCTIONAL OBJECTIVES	TERMINAL BEHAVIORS
5. Identify inside and outside of curves; circle, square, and triangle.	a. Locate points inside curves. b. Locate area outside curves in reference to plane figure.
6. Identify regions of circle, square, and triangle.	a. Understand each curve defines a region. b. Locate regions of three curves. 1) texture surface 2) color coding

MATERIALS DEVELOPMENT PROSPECTUS

CONCEPT AREA: Geometry

GRADE LEVEL: III-Three Dimensional Figures

INSTRUCTIONAL OBJECTIVES	TERMINAL BEHAVIORS
1. Identify the properties of an angle.	a. Observe that a ray has one end point. b. Observe that angles are made up of two rays. c. Observe that an angle has a common end point called the corner point. d. One angle may have at least two assigned letter names. e. Identify an angle. 1) locate the two rays of the angle 2) locate the two end points of the rays 3) locate the corner point of the angle 4) Identify the two assigned letter names of the angle
2 Identify the properties of a right angle.	a. Review first objective and apply to right angle. b. Observe "squareness"of right angle to associate this characteristic to a right angle. c. Identify different configurations of right angles.
3. Identify the angles of a square and triangle.	a. Locate the four right angles of a square. b. Locate the right angle and remaining angles of a right triangle. c. Locate angles of obtuse and acute triangles.
4. Identify the properties of a circle.	a. A circle is a closed curve. b. Understand a circle is perfectly round. c. Locate the center point of a circle and recognize every point on the circle is the same distance from the center point. d. Understand a diameter is the measure of the distance across the circle through the center point; locate the diameter of a circle. (cont.)

MATERIALS DEVELOPMENT PROSPECTUS

CONCEPT AREA: Geometry

GRADE LEVEL: III-Three Dimensional Figures

INSTRUCTIONAL OBJECTIVES	TERMINAL BEHAVIORS
	(cont.) e. Understand a line segment making up half the diameter is called a radius; locate a radius of a circle. f. Understand radiuses of the same circle are of equal length. g. Understand end points of a radius may serve as either the center point of the circle or a point on the circle.
5. Identify a plane surface.	a. Observe plane surfaces are flat; investigate examples. b. Recognize any line segment connected by two points which lies entirely on the surface is lying on a plane.
6. Identify properties of parallel lines.	a. Understand if two lines in the same plane do not meet, they do not form an angle. Two lines of this kind are parallel. b. Identify examples
7. Identify a sphere and a cube.	a. Recognize and correctly name an example of each.

CHART IV

GEOMETRIC CONCEPT ANALYSIS

INTERMEDIATE LEVEL

CONTENT UNIT: Geometry

GRADE LEVEL: IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
1. Identify the properties of points, curves, lines, and rays.	a. A curve is a set of connected points. b. A line goes on and on in two directions. c. A line segment has two end points. d. A ray has one end point and goes on and on in one direction.	1) Each concept is theoretically pictured. 2) Student is to identify the concepts, given a set of real life examples.
2. Identify the properties of an intersection using points and lines.	a. The point at which two lines cross each other is called an intersection. b. Real life examples portray intersections. (Example: two highways crossing) c. The point at which two lines cross may be given a name. Each line is given a name. d. There are different examples of an intersection. 1) intersection of 2 sides of a geometric shape 2) intersection of a line crossing parallel lines 3) intersection of lines (vertical, horizontal) of a graph e. Two lines will not always intersect. (Example: parallel lines) f. Two lines cannot intersect in more than one place.	1) Name the line segments of examples given. 2) Name the intersections of examples given.

GRADE LEVEL: IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
3. Identify properties of a plane.	a. A plane is a flat surface that goes on and on in all directions. b. A rounded surface is not flat, so it cannot be thought of as a plane.	1) Given an example of two points in a plane, observe: a. an indefinite number of lines can be drawn through each point. b. only one line can pass through two points in the same plane. c. all points on the line passing two points in the same plane are on the plane.
4. Identify angles using joining rays.	a. The joining or union of two rays with a common end point is called an angle. b. Angles may be named. c. The common end point of two rays forming an angle is called the vertex of the angle. d. The two rays of an angle are the sides of the angle. e. One angle may have pairs of rays different lengths.	1) Name rays sharing a common end point or vertex. 2) Name angles. 3) Name angles with a common ray.
5. Identify and name right angles.	a. Child is to understand the configuration of a right angle. b. A vertical line forming two right angles on a horizontal line illustrates a perpendicular relationship.	1) Identify a perpendicular relationship using the edges of the textbook page. 2) Identify and name right angles.

CONTENT UNIT: Geometry

GRADE LEVEL IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS
6. Identify Parallel lines.	a. Parallel lines are in the same plane and never meet to form an angle. b. The distance between a pair of parallel lines is always the same.	1) A parallel relationship is demonstrated using a real life example. 2) Identify parallel line segments. 3) Construct parallel lines.
7. To successfully answer questions about parallel, congruent, and perpendicular relationships.	a. A street map may illustrate parallel, perpendicular, and intersect relationships. b. The geometric shape of a rectangle will illustrate a congruent, parallel, and perpendicular relationship.	1) Identify and name congruent, parallel, and perpendicular lines.
8. To distinguish the difference between a simple closed curve, a curve that is not closed, and a closed curve that is not simple.	a. The student will understand the following by observing pictorial illustrations. 1) A curve is a set of points connected to form a path. 2) A curve that is not closed is a figure whose end points are not joined together. 3) A curve that begins at a point and returns to that point without crossing itself is a simple closed curve. 4) A curve that begins at a point and returns to that point and crosses itself is a curve that is not simple.	1) Identify the three types of curves. 2) Identify points inside, outside, and on a closed curve. 3) Observe lines connected between points inside, outside, and on a closed curve may intersect that curve.

GRADE LEVEL: IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
9. To distinguish four types of quadrilaterals as being polygons.	a. Quadrilaterals are polygons with four sides. 1) quadrilateral 2) parallelogram 3) rectangle 4) square b. The vertices of a quadrilateral may be labeled. c. The distance around a polygon is called its perimeter. d. The perimeter is determined by adding together the length of the sides of the polygon.	1) Name the parallel and congruent sides of a parralelogram. 2) Name the congruent sides of a rectangle. 3) Identify the number of right angles of a rectangle. 4) Name perimeters of quadrilaterals.
10. To review the properties of a circle and regions of geometric figures.	a. A circle is a simple closed curve with all points the same distance from the center. b. A radius is a line segment with one end point at the center and the other end point on the circle. c. A diameter is a line segment which passes through the center and whose end points are on the circle. d. The surface area inside a closed curve is the region of the closed curve.	1) Identify and name radii and diameters. 2) Determine a radius is half of a diameter. 3) Identify the width of a circle as the measure of its diameter. 4) Associate the surface area within a closed curve as its region.
11. Identify symmetrical figures using symmetrical and non-symmetrical pictorial illustrations as examples.	a. A figure that is symmetrical has a line about which each figure is symmetrical. b. A symmetrical figure may have more than one line about which it is symmetrical.	1) Identify symmetrical figures. 2) Name line segments about which a figure is symmetrical. 3) Identify real life examples of symmetrical figures. 4) Identify the different lines about which a square can be symmetrical.

CONTENT AREA: Geometry

GRADE LEVEL: IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
12. To identify points inside, outside, and on a simple closed surface.	a. A simple closed surface separates points into three sets; inside, outside, and on.	1) Discriminate inside, outside, and on using a pictorial illustration.
13. To identify the properties of a simple closed surface called a sphere.	a. Identify the shape of a sphere. b. The surface area of the center of a ~~cone~~ Sphere defines a circular region.	1) Answer questions regarding the properties of a sphere using a model.
14. To identify the properties of a simple closed surface called a cone.	a. Identify the shape of a cone using a three dimensional figure. b. The base of a cone defines a circular region.	1) Construct a cardboard cone. 2) Answer questions regarding the properties of a cone using the model.
15. To identify the properties of a simple closed surface called a cylinder.	a. A tin can is an example of a cylinder. b. The bases of a cylinder are usually circular regions. c. The height of a cylinder is the shortest distance between the bases.	1) Answer questions regarding the properties of a cylinder using the pictorial diagram.
16. To identify the properties of a simple closed surface called a cube.	a. The regions of the planes of a cube are called faces or sides. b. The line segments on a cube are called edges. c. The corner points on a cube are called vertices.	1) Construct a cardboard cube. 2) Answer questions regarding the properties of a cube using the model. 3) Count the edges of the cube and identify how many pairs of edges are parallel. 4) Count how many vertices the cube has and how many planes meet at each vertex. 5) Identify the shape of the faces.

Geometry

GRADE LEVEL: IV

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
17. To identify the properties of a simple closed surface called a pyramid.	a. The regions of the planes of a pyramid are called faces or sides. b. The line segments on a pyramid are called edges. c. The corner points on a pyramid are called vertices.	1) Construct a cardboard pyramid. 2) Answer questions regarding the properties of a pyramid using the model.
18. To identify parallel planes and those planes that intersect to form angles.	a. Planes that intersect in a line form an angle. b. Planes which do not intersect are parallel. c. Planes may share a common line or point. d. Planes may meet to form three dimensional geometrical figures.	1) Identify planes forming angles and parallel planes. 2) Identify planes which share a common line segment or point. 3) Identify real life examples of parallel and intersecting planes. 4) Identify planes and vertices of a three dimensional figure.
19. To observe how points, line segments, rays, and angles lie in a plane.	a. A plane is a set of points in a flat surface extending in all directions.	1) Identify and name line segments, rays, and points lying in a plane. 2) Observe that a line intersecting a plane has only one point in common with the plane.

UNIT: Geometry

GRADE LEVEL: V

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
1. To identify properties of a simple closed surface called a sphere.	a. A sphere is a simple closed surface which is completely round b. Every point on the sphere is the same distrance from the center point of the sphere.	1) Identify diameters and radii of spheres. 2) Construct a sphere shaped object using cardboard circles.
2. To observe simple closed surfaces which have curved surfaces.	a. Not all simple closed surfaces are formed by plane regions. b. Cylinders and cones are examples of surfaces which are curved. c. The base of a cone or cylinder is usually a circular region.	1) Construct cardboard cylinders and cones. 2) Identify real life examples of cylinders and cones.
3. To identify the properties of simple closed surfaces.	a. A closed surface is one which does not lie entirely in one place. b. The union of 4 or more plane regions is a simple closed surface. c. Simple closed surfaces have planes called faces or sides, line segments called edges, and corner points called vertices. d. Examples of simple closed surfaces are: 1) tetrahedron 2) cube 3) rectangular prism 4) triangular prism e. A pyramid is named according to the shape of its base. 1) square pyramid 2) rectangular pyramid 3) pentagonal pyramid f. Closed surfaces whose edges and angles are all congruent are said to be regular.	1) Count number of faces, vertices, and edges of simple closed surfaces. 2) Identify shape of faces of simple closed surfaces.

CONTENT UNIT: Geometry

GRADE LEVEL: V

INSTRUCTIONAL OBJECTIVES	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
4. To identify a method of measuring the size of an angle.	a. An angle is the union of two rays with a common end point. b. The rays are the sides of the angle. c. The end point of the angle is the vertex. d. An angle is measured by comparing it with a unit angle. e. The size of an angle is the measure together with the unit. f. Two angles the same size are congruent.	1) Angles are pictured with unit angles. Unit angles are counted to determine the measure of an angle. 2) Pairs of congruent angles are identified by matching angles with identical unit angle measures.
5. To identify parallel planes and parallel lines within more than one plane.	a. Lines in the same plane which do not intersect are parallel. b. Planes which do not intersect are parallel planes.	1) Identify parallel planes from examples. 2) Identify parallel line segments within planes.
6. To identify relationships between points, lines, and planes.	a. A line and a point not on the line will fix a plane. b. There is only one plane which will pass through a line and a point not on the line.	1) Planes are color coded; points, line segments, and rays are identified in planes. 2) Relationships are identified between points, lines, and planes using the classroom ceiling, walls, and floor.
7. Identify properties associated with special simple closed curves that are polygons.	a. A polygon is a simple closed curve formed by the union of line segments. 1) triangle 2) quadrilateral 3) pentagon 4) hexagon b. Line segments are called sides; corner points are called vertices. Both are labeled with capital letters. c. The surface area inside the polygons are called regions. d. The circle and ellipse are not polygons since they are not formed by line segments.	1) Name polygons. 2) Name the number of sides and vertices for polygons.

CONTENT UNIT: Geometry

GRADE LEVEL: V

INSTRUCTIONAL OBJECTIVE:	CONCEPTS TO BE TAUGHT:	TEACHING PROCESS:
8. Identify curves which lie in one plane.	a. A set of points, in a flat surface, that goes on and on in all directions without end is a plane. b. The following plane figures lie in one plane. 1) line 2) line segment 3) ray 4) curve 5) closed curve 6) simple closed curve	1) Identify sets of points from the above examples represented as real life examples in a pictorial illustration.

CHART V

GEOMETRIC CONCEPT ANALYSIS

INTERMEDIATE LEVEL

PERFORMANCE OPERATIONS

Performance Operations - Primary Level*

Geometric Concept	Measurement Concept
Grade I	Grade I
1. Line segments are used in measurement exercises.	1. Unit of measure is the inch. 2. Measurement device is the ruler.
Grade II	Grade II
1. Line segments are used in measurement exercises. 2. Sides of geometric shapes are used in measurement exercises.	1. Unit of measure is the inch. 2. Twelve inches equal one foot 3. Measurement device is the ruler.
Grade III	Grade III
1. Line segments are used in measurement exercises. 2. Line segments are drawn.	1. Unit of measure is the inch. 2. The inch can be subdivided into two or four parts. 3. Twelve inches equal one foot 4. Another unit of measure is the centimeter which is a little smaller than one half inch. 5. Measurement device is the ruler with inch or centimeter units.

*Modern Mathematics Structure and Use

PERFORMANCE OPERATIONS

FOURTH GRADE

MODERN SCHOOL MATHEMATICS, STRUCTURE AND USE

Page 68.

(1) Measurement of line segments

(2) Introduction to measuring line segment using an inch unit of measure

Page 69.

(1) Using a ruler to measure line segments

(2) Using ruler to draw line segments

(3) A ruler shows measures of 1/4, 1/2, 3/4 inches.

Page 79.

(1) Draw circles using a piece of cardboard and two pencils

(2) Measure radii and draw circles; fractions of an inch included

(3) Copy drawings

Page 260.

(1) Copy patterns of cutout pyramid. Cut out pattern and fold to construct pyramid

Page 261.

(1) Repeat with cube

Page 263.

(1) Repeat with cone

Page 266.

(1) Measure line segments using ruler

Page 267.

(1) Draw rectangles of specified measures and determine how many square inches match the rectangular region.

Page 268
269

(1) Find the volume of 3 dimentional figures by discriminating measures of cubic units within the figure to compute the volume.

PERFORMANCE OPERATIONS

FIFTH GRADE

MODERN SCHOOL MATHEMATICS, STRUCTURE AND USE

Page 68.

(1) Measure line segments

(2) Identify congruent line segments

Page 69.

(1) Measure the perimeters of polygons

Page 71.

(1) Introduction to protractor by identifying the number of degrees in an angle. Protractor drawn in book.

Page 72.

(1) Use a protractor to measure angles

(2) Use a protractor to draw angles

Page 73.

(1) Measure angles

Page 74.

(1) Use ruler to measure line segments of polygons

(2) Use protractor to measure angles of polygons

Page 75.

(1) Use ruler to measure line segments of special parallelograms

(2) Use protractor to measure angles of special parallelograms

Page 76.

(1) Draw circles using a piece of card board and two pencils

(2) Measure line segments and angles within circles

Page 77.

(1) Measure line segments within ellipses.

Page 86.

(1) Draw squares and rectangles of specified measures and find their areas by using a cutout square inch. (Gava)

Page 87.

(1) Construct cubes of specified measures and find their volume by using a cutout cubic inch. (Gava)

Page 88 - 89.

(1) Locate and name points and number paris for the pints on number planes.

Page 90.

(1) Identify number pairs on number planes.

(2) Draw a number plane and label points and draw figures

Page 91.

(1) Draw a graph using specified data

Page 92.

(1) Draw a bar graph using specified data.

Page 93.

(1) Draw a double bar graph using specified data.

PERFORMANCE OPERATIONS

SIXTH GRADE

MODERN SCHOOL MATHEMATICS, STRUCTURE AND USE

Page 69.

1) Draw line segments and rays.

Page 70.

1) Measure and draw line segments.

Page 71.

(1) Draw Angles.

Page 72.

1) Use protractor to measure angles.

Page 73.

1) Measure line segments and angles.

2) Use protractor to draw angles

Page 74.

1) Descriptive

Page 75.

1) Measure Line segments and angles.

2) Draw right triangles

Page 76.

1) Use protractor and ruler to measure line segments and angles.

Page 78.

1) Giva

Page 79.

1) Descriptive

Measuring area.

Page 80.

1) Use protractor and ruler to measure line segments and angles.

2) Use compass to draw circles.

Page 81.

1) Use compass and ruler to construct triangles and rectangles.

Page 82.

1) Measure line segments and angles.

2) Use protractor and ruler to construct triangles.

Page 83.

1) Descriptive - pythagorian theorem.

Page 84.

1) Construct a hexagon using a compass and ruler.

2) Construct triangles using ruler and compass.

Page 85.

1) Construct triangles using a ruler and compass

Page 86.

1) Descriptive - planes - three dimensional

Page 87.

1) Descriptive - planes - three dimensional

Page 88 - 89.

1) Descriptive - special closed surfaces

Page 90.

1) Descriptive - sphere

Page 91.

1) Measuring volume - three dimensional - Gava

Page 92.

1) Finding surface area of cubes and rectangular prisms.

Page 93.

1) Find volume and surface area of 3 - dimensionsal figures

Page 94.

1) Draw number plane.

Page 95.

1) Draw number plane

Page 268.

1) Use ruler and protractor to measure line segments and angles.

Page 269.

1) Descriptive - measurement of regions.

Page 270.

1) Descriptive - measuring space regions.

Page 271.

1) Descriptive - measureing surface area of closed surfaces.

Page 272.

1) Cutout circle - find circumference by rolling region along line segment.

Page 273.

1) Descriptive - area of circular region.

Page 274.

1) Descriptive - Pythagorian theorem

Page 275.

1) Descriptive - Volumes and areas

Page 276.

1) Linear Pairs - use protractor to measure angles.

Page 277.

1) Measure angles - protractor.

Page 278.

1) Measure angles - protractor.

Page 279.

1) Measure angles - protractor.

Page 280.

1) Measure angles and line segments.

2) Draw congruent triangles.

Page 281.

1) Construct perpendiculars without protractor - use compass.

Page 282.

1) Use compass to draw perpendicular bisectors of line segments.

Page 283.

1) Use protractor to identify angle bisectors.

2) Draw angle bisectors.

3) Draw a triangle and angle bisectors.

Page 284.

1) Cut out strips of cardboard and make a triangle and quadrilateral.

Page 286.

1) Measure line segments - name ratios.

Page 287.

1) Descriptive - ratios.

Page 288.

1) Draw similar geometric shapes - make drawing.

Page 289.

1) Descriptive - ratios.

Page 290.

1) Descriptive - Intersecting planes and closed figures.

Page 291.

1) Draw ellipses.

Page 292.

1) Draw number planes.

Page 293.

1) Draw specified symmetrical figures.